# ORIGINAL ARTICLE

## The Effect of the Blended Learning Approach Compared with the Traditional method in Oral Diagnosis Education during COVID-19 Pandemic

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**Background:** Internet-based e-learning has become one of the dominant approaches in educational systems. The aim of the present study was to examine the effect of the blended learning approach compared with the conventional method in dental education (oral diagnosis course) during the COVID-19 pandemic.

**Method:** The present experimental study was conducted in 2020. A total of 76 (n=76) fourth-year general dentistry students from the school of dentistry of Ahvaz Jundishapur University of Medical Sciences (AJUMS) participated in the study. All students had chosen the Oral Diseases and Diagnosis course (Practical course 1). The students were divided into two equal groups (group A, Group B, n=38) according to age, sex and grade point average. Teaching in Group A was conducted traditionally in a physical learning environment. Students in Group B received theoretical topics in the form of offline-online education and practiced clinical skills (like group A) in the clinical settings. The posttest intervention was conducted immediately and one month after the educational program. Data were analyzed using SPSS version 26.

**Results:** The mean test score of students (immediately and one month after the educational program) via the traditional instruction method was lower than the blended instructional method (p<0.001). The mean score of students in both groups in the one month follow up exam decreased significantly compared with the immediate posttest exam (p<0.01).

**Conclusion:** Blended learning with the educational benefits of online learning and face-to-face learning has the greatest impact on the immediate and long-term academic achievement compared to traditional learning.

**Keywords:** Blended learning; Traditional learning; COVID-19, Pandemics, Dentistry

تأثير أسلوب التعلم المدمج مقارنة بالطريقة التقليدية في تعليم التشخيص الشفهي أثناء جائحة كوفيد-١٩

**الخلفية:** أصبح التعلم الإلكتروني عبر الإنترنت أحد الأساليب السائدة في الأنظمة التعليمية. كان الهدف من هذه الدراسة هو فحص تأثير نهج التعلم المدمج مقارنة بالطريقة التقليدية في تعليم طب الأسنان (دورة التشخيص الفموي) خلال جائحة كوفيد-١٩.

**الطريقة:** أجريت الدراسة التجريبية الحالية في عام ٢٠٢٠. وشارك في الدراسة ما مجموعه ٧٦ (ن = ٧٦) من طلاب طب الأسنان العام في السنة الرابعة من كلية طب الأسنان بجامعة أهواز جنديسابور للعلوم الطبية (AJUMS). اختار جميع الطلاب مقرر أمراض الفم والتشخيص (الدورة العملية ١). تم تقسيم الطلاب إلى مجموعتين متساويتين (المجموعة أ، المجموعة ب، العدد = ٣٨) حسب العمر والجنس والمعدل التراكمي. تم التدريس في المجموعة (أ) بشكل تقليدي في بيئة تعليمية مادية. تلقى الطلاب في المجموعة ب موضوعات نظرية في شكل تعليم غير متصل بالإنترنت ومارسوا المهارات السريرية (مثل المجموعة أ) في الإعدادات السريرية. تم إجراء التدخل البعدي مباشرة وبعد شهر واحد من البرنامج التعليمي. تم تحليل البيانات باستخدام برنامج SPSS الإصدار ٢٦.

**النتائج:** كان متوسط درجات اختبار الطلاب (مباشرة وبعد شهر من البرنامج التعليمي) بطريقة التدريس التقليدية أقل من طريقة التدريس المدمج (P<0.001). انخفض متوسط درجات الطلاب في كلا المجموعتين في اختبار المتابعة لمدة شهر واحد بشكل ملحوظ مقارنة مع الاختبار البعدي المباشر ( P <0.01).

**الاستنتاج:** إن التعلم المدمج مع الفوائد التعليمية للتعلم عبر الإنترنت والتعلم وجهاً لوجه له الأثر الأكبر على التحصيل الأكاديمي الفوري والطويل المدى مقارنة بالتعلم التقليدي.

**الكلمات المفتاحية:** التعلم المدمج؛ التعلم التقليدي؛ كوفيد-١٩، الأوبئة، طب الأسنان

تأثیر رویکرد یادگیری ترکیبی در مقایسه با روش سنتی در آموزش تشخیص بیماری های دهان در دوران همه‌گیری کووید ۱۹

**زمینه و هدف:** آموزش الکترونیکی مبتنی بر اینترنت به یکی از رویکردهای غالب در سیستم های آموزشی تبدیل شده است. هدف مطالعه حاضر بررسی تأثیر رویکرد یادگیری ترکیبی در مقایسه با روش مرسوم در آموزش دندانپزشکی (درس تشخیص دهانی) در دوران همه‌گیری کووید ۱۹ می باشد.

**روش:** مطالعه تجربی حاضر در سال ۱۳۹۹ انجام شد. تعداد ۷۶ نفر دانشجوی سال چهارم دندانپزشکی عمومی از دانشکده دندانپزشکی دانشگاه علوم پزشکی جندی شاپور اهواز در مطالعه شرکت کردند. کلیه دانشجویان درس بیماریهای دهان و تشخیص (درس عملی ۱) را انتخاب کرده بودند. دانشجویان بر اساس سن، جنس و معدل به دو گروه مساوی (گروه A، گروه B، ۳۸=n) تقسیم شدند. تدریس در گروه A به طور سنتی در یک محیط یادگیری فیزیکی انجام شد. دانشجویان گروه B مباحث نظری را در قالب آموزش آفلاین-آنلاین دریافت کردند و مهارت‌های بالینی (مانند گروه A) را در محیط‌های بالینی تمرین کردند. مداخله پس آزمون بلافاصله و یک ماه پس از برنامه آموزشی انجام شد. داده ها با استفاده از نرم افزار SPSS نسخه ۲۶ تجزیه و تحلیل شد.

**یافته‌ها:** میانگین نمره آزمون دانشجویان (بلافاصله و یک ماه بعد از برنامه آموزشی) به روش آموزش سنتی کمتر از روش آموزش ترکیبی بود (p<۰/۰۰۱). میانگین نمرات دانشجویان هر دو گروه در آزمون پیگیری یک ماهه نسبت به آزمون فوری پس‌آزمون کاهش معنی‌داری داشت (p<۰/۰۱)

**نتیجه‌گیری:** یادگیری ترکیبی با مزایای آموزشی یادگیری آنلاین و یادگیری حضوری بیشترین تأثیر را در پیشرفت تحصیلی فوری و بلندمدت نسبت به یادگیری سنتی دارد.

**واژه‌های کلیدی:** یادگیری ترکیبی. یادگیری سنتی. کووید ۱۹، بیماری های همه گیر، دندانپزشکی

COVID-19 وبائی امراض کے دوران زبانی تشخیص کی تعلیم میں روایتی طریقہ کے مقابلے ملاوٹ شدہ سیکھنے کے نقطہ نظر کا اثر

**پس منظر:** انٹرنیٹ پر مبنی ای لرننگ تعلیمی نظاموں میں ایک غالب طریقہ بن گیا ہے۔ موجودہ مطالعے کا مقصد COVID-19 وبائی امراض کے دوران دانتوں کی تعلیم (زبانی تشخیص کے کورس) میں روایتی طریقہ کے مقابلے ملاوٹ شدہ سیکھنے کے نقطہ نظر کے اثر کو جانچنا تھا۔

**طریقہ:** موجودہ تجرباتی مطالعہ ۲۰۲۰ میں کیا گیا تھا۔ اہواز جندیشا پور یونیورسٹی آف میڈیکل سائنسز (AJUMS) کے اسکول آف دندان سازی کے چوتھے سال کے عمومی دندان سازی کے کل ۷۶ (76=n) طلباء نے مطالعہ میں حصہ لیا۔ تمام طلباء نے منہ کی بیماریوں اور تشخیص کا کورس (عملی کورس ۱) کا انتخاب کیا تھا۔ طلباء کو عمر، جنس اور گریڈ پوائنٹ کی اوسط کے مطابق دو مساوی گروپس (گروپ A، گروپ B، ۳۸=n) میں تقسیم کیا گیا تھا۔ گروپ A میں تدریس روایتی طور پر جسمانی تعلیمی ماحول میں کی جاتی تھی۔ گروپ B کے طلباء نے آف لائن آن لائن تعلیم کی شکل میں نظریاتی موضوعات حاصل کیے اور طبی ترتیبات میں طبی مہارت (جیسے گروپ A) کی مشق کی۔ پوسٹ ٹیسٹ مداخلت فوری طور پر اور تعلیمی پروگرام کے ایک ماہ بعد کی گئی۔ SPSS ورژن ۲۶ کا استعمال کرتے ہوئے ڈیٹا کا تجزیہ کیا گیا۔

**نتائج:** روایتی تدریسی طریقہ کے ذریعے طلباء کا اوسط ٹیسٹ سکور (تعلیمی پروگرام کے فوراً بعد اور ایک ماہ بعد) ملاوٹ شدہ تدریسی طریقہ (0.001 > p) سے کم تھا۔ ایک ماہ کے فالو اپ امتحان میں دونوں گروپوں میں طلباء کے اوسط اسکور میں فوری پوسٹ ٹیسٹ امتحان (0.01 > p) کے مقابلے میں نمایاں کمی واقع ہوئی۔

**نتیجہ:** آن لائن سیکھنے اور آمنے سامنے سیکھنے کے تعلیمی فوائد کے ساتھ مخلوط سیکھنے کا روایتی سیکھنے کے مقابلے میں فوری اور طویل مدتی تعلیمی کامیابیوں پر سب سے زیادہ اثر پڑتا ہے۔

**مطلوبہ الفاظ:** ملاوٹ شدہ سیکھنے؛ روایتی تعلیم؛ COVID-19، وبائی امراض، دندان سازی۔

## INTRODUCTION

The world has made progress in the last couple of decades. One of the criteria for social progress is academic achievement in educational systems. Education is one of the major needs of the human being. In recent years, the information technology is continuously changing and progressing faster than ever. Those groups in society who have not followed and ignored the scientific developments have deprived themselves from the benefits of scientific advancement (1,2). With the growth of population over the years, the education authorities cannot meet the long-term educational needs of the expected population growth. Therefore, new and low-cost pedagogical approaches are required to facilitate teaching and learning (1).

Since the early twentieth century, Internet-based e-learning has become one of the dominant approaches in educational systems (3). E-learning is an appropriate response to the human need for continuing education and provides a well-rounded background for learning and teaching in a digital learning environment. (4,5).

The outbreak of coronavirus disease (COVID-19) has posed a continued public health risk that affected all parts of society. The COVID-19 pandemic has brought momentous disruptions to educational systems. At the onset of COVID-19 outbreak, universities and higher education institutions across the globe were forced to suspend academic activities. The sudden closure of face-to-face educational learning has changed the entire education system from traditional learning to e-learning, distance education, and online learning. Similarly, dental schools have suspended the traditional education system and shifted their academic activities to online learning. Dental students are at the highest risk of contracting the virus in their academic activities. Furthermore, the scientists still have restricted data about COVID-19, and the highest level of personal protective equipment is required (6).

E-learning has definite benefits compared with traditional classroom setting including: providing rich educational content and interactions, strengthening teaching and learning strategies, sharing information to create a sustainable information society, flexibility, and avoiding unnecessary costs of e-learning. Also, the cost of e-learning courses is not expensive and these courses can be held using the available software and tools. Moreover, learners can manage their own learning and adjust their own learning pace (1,7).

Most of the e-learning programs are accessible at the time and place that suits the learners. The e-learning courses provide fast delivery of information across platforms compared with traditional courses (up to 50 percent faster than traditional courses). E-learning provides a higher degree of coverage to interconnect the message for their target audience, consistently. E-learning is flexible and has the potential to create additional learning opportunities independent of time and place. E-learning contents are presented in the form of text, image, sound, and motion videos, which are more attractive to the audience, and pen and paper are less required for note-taking (7).

In the recent decades, remarkable advances have been made in the medical and dental sciences. In the traditional classroom teaching model, the large volume of new topics cannot be covered due to time constraints. Therefore, the instruction of theoretical topics has gradually changed to lecture-based instruction which is recognized as the least 'engaging' method of teaching. Studies have shown that face-to-face class and traditional classroom-based learning activities are boring and predetermined in their content and schedule, which may affect school learning. In e-learning, however, the student can access the educational content at any time which leads to an increase in the effectiveness of this method (8). In medical sciences education, a growing tendency has been made to replace traditional education with e-learning to meet the needs of students and facilitate access to information and other technological capabilities (9).

With increases in higher education attendance and educational costs, traditional education can no longer meet the needs of the current generation. Therefore, new learning methods such as e-learning are required for technical support and training. E-learning refers to the application of new technologies such as the Internet and multimedia in education. The advantages of e-learning are active and independent learning without time and space restrictions. However, e-learning has some disadvantages such as lack of human and emotional interactions, face-to-face feedback, and lack of social communication skills. E-learning and traditional learning limitations have led to the emergence of complementary method, i.e., blended (Hybrid) education (4).

The blended learning method is a combination of face-to-face (traditional classroom) and online approaches. There are various models for blended teaching methods, including face-to-face driver model, rotation model, flex model, online lab model, self-blend model, and online driver model. The most common form of blended learning is the face-to-face driver model, in which teaching and learning are carried out the same as face-to-face training, but opportunities are provided for the learner to engage with the content of the lesson outside the classroom and in cyberspace (3).

According to the educational curriculum of general dentistry in Iran, the course of oral diseases (practice 1) is more focusing on the topics of "internal and external oral examination, cerebral nerve examination, salivary gland examination, lymph node and thyroid examination, temporomandibular joint examination, oral mucosal trauma and injuries, and dental measures for systemic diseases (cardiovascular-endocrine-respiratory) (10).

Considering the importance of e-learning and blended learning methods in medicine and dentistry, especially during the COVID-19 pandemic, the present study examined the effect of the blended learning approach compared with the conventional method in dental education (oral diagnosis course) during the COVID-19 pandemic.

## METHODS

The present experimental study was conducted in 2020. A total of 76 (n=76) fourth-year general dentistry students

from the school of dentistry of Ahvaz Jundishapur University of Medical Sciences (AJUMS) participated in the study. All students had chosen the Oral Diseases and Diagnosis course (Practical course 1). The exclusion criteria were that the students had not yet taken or passed the Diagnosis course 1. In this course, the following items are taught as class lectures and discussion:

1- Familiarity with systemic diseases and dental considerations of these diseases,

 2- Oral cavity lesions,

3- Clinical extra oral and intraoral examination.

A written informed consent was obtained from all the participants. The students were divided into two equal groups (group A, Group B) according to age, sex, and grade point average.

Group A (n=38): Teaching was conducted traditionally in a physical learning environment. The students performed skillful activities such as patient examination, diagnosis and treatment plan in clinical settings and received other topics traditionally (lecture-based instructional approach).

Group B (n = 38): Students in this group received theoretical topics in the form of virtual education (offline-online) and practiced clinical skills (like group A) in clinical settings.

The theoretical topics were provided via nine electronic media, especially via the Internet. The following sub-topics were prepared and uploaded by the faculty members: 1- Dental measures for cardiovascular diseases including hypertension, endocarditis and other heart diseases, 2- Dental measures for endocrine diseases including diabetes and thyroid disease, 3- Dental measures for respiratory diseases including asthma and oral ulcers (Single or multiple ulcers, acute ulcers, and recurrent ulcers).

The contents were uploaded to an online education system recommended by AJUMS during the outbreak of COVID-19. Students viewed one content on the online system each week. For more students–faculty interaction, the online student forums and peer review groups were activated in the online support environment.

The intervention lasted 9 weeks plus one week of post-testing. In the first week after the end of the training (November), a test was taken from the students to evaluate the effect of immediate learning using multiple-choice test and descriptive questionnaire with case presentation. In order to avoid bias in the study, the paper sheet questionnaire was anonymous and the students were asked to write student ID numbers rather than names. The paper sheets were reviewed by an oral disease specialist who had no direct role in the education process. To evaluate the long-term effect of education, a test was taken from students after one month (December) and finally the students' scores in both tests were analyzed, statistically. The final evaluation was composed of a combination of multiple-choice test, descriptive questionnaire, and case presentation (9). To determine the validity of the designed questions, it was reviewed and reviewed by five academic staff members specializing in oral diseases.

### Data analysis

Data were analyzed using descriptive and inferential statistics. Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to describe/summarize the characteristics of the data set. The intergroup comparison of demographic information was carried out using the independent t-test. The differences in the qualitative variables between the study groups were measured using the Chi-square test. The effect of blended and traditional teaching on students´ learning performance was analyzed using repeated-measures analysis of covariance. The assumption of sphericity is tested with Mauchly's Test for Sphericity. Data were analyzed using SPSS (SPSS Inc., Chicago, Ill., USA) version 26.

## RESULTS

The demographic information of the participants is presented in Table 1.

### Blended/traditional method assessment

In the present study, the assumption of Mauchly's sphericity was not met. Therefore, the Greenhouse-Geisser corrected tests were reported for these analyses. According to the

| Table 1. Demographic information of participants | | | | |
|---|---|---|---|---|
| **Demographic variables** | **Total** | **Group A** | **Group B** | **F** |
| **Residence Status** | | | | |
| Living with family | 26(34.21%) | 13(17.10%) | 13(34.21%) | $\chi^2_2=0.166$ |
| Dormitory | 43(56.58) | 22(57.89%) | 21(58.33%) | |
| Living alone | 7(9.21%) | 3(7.89) | 4(10.52%) | |
| **Father's Education** | | | | |
| Less than diploma | 4(5.26%) | 1(2.63%) | 3(7.89%) | |
| Diploma | 18(1.31%) | 13(34.21%) | 5(13.15%) | |
| Associate degree | 6(7.89%) | 3(7.89%) | 3(7.89%) | $\chi^2_5=9.041$ |
| Bachelor | 28(36.84%) | 11(28.94%) | 17(44.73%) | |
| Master | 10(13.15%) | 7(18.42%) | 3(7.89%) | |
| Ph.D | 10(13.15%) | 3(7.89%) | 7(18.42%) | |

| Table 1. Continued | | | | |
|---|---|---|---|---|
| **Demographic variables** | **Total** | **Group A** | **Group B** | **F** |
| **Mother's education** | | | | |
| Less than diploma | 5(6.57%) | 1(2.63%) | 4(10.52%) | |
| Diploma | 28(36.84%) | 18(47.36%) | 10(26.31%) | |
| Associate degree | 10(13.15%) | 7(18.42%) | 3(7.89%) | $\chi^2_5=8.701$ |
| Bachelor | 27(35.52%) | 10(26.31%) | 17(44.73%) | |
| Master | 1(1.31%) | 0(0%) | 1(2.63%) | |
| Ph.D | 5(6.57%) | 2(5.26%) | 3(7.89%) | |
| **Father's occupation** | | | | |
| Housewife / unemployed / deceased | 4(5.26%) | 2(5.26%) | 2(5.26%) | |
| Retired | 16(21.05%) | 9(23.68%) | 7(18.42%) | |
| Self-employed | 11(14.47%) | 7(18.42%) | 4(10.52%) | $\chi^2_5=4.041$ |
| Employee | 23(30.26%) | 9(2.68%) | 14(36.84%) | |
| Doctor | 7(9.21%) | 2(5.26%) | 5(13.15%) | |
| Cultural Careers/Faculty | 15(19.73%) | 9(23.68%) | 6(15.78%) | |
| **Mother's occupation** | | | | |
| Housewife / unemployed / deceased | 43(56.57%) | 25(65.78%) | 18(47.36%) | |
| Retired | 6(7.89%) | 2(5.26%) | 4(10.52%) | |
| Self-employed | 7(9.21%) | 4(10.52%) | 3(7.89%) | $\chi^2_5=4.051$ |
| Employee | 7(9.21%) | 2(5.26%) | 5(13.15%) | |
| Doctor | 2(2.63%) | 1(2.63%) | 1(2.63%) | |
| Cultural Careers/Faculty | 11(14.47%) | 4(10.52%) | 7(18.42%) | |
| **Eemployment status** | | | | |
| Unemployed | 66(86.84%) | 32(84.21%) | 34(89.47%) | $\chi^2_1=0.461$ |
| Employed | 10(13.15%) | 6(15.78%) | 4(10.52%) | |
| **Marital status.** | | | | |
| | | | | $\chi^2_1=0.559$ |
| Single | 68(89.47%) | 33(86.84%) | 35(92.10%) | |
| Married | 8(10.52%) | 5(13.15%) | 3(7.89%) | |
| **Clinical work experience** | | | | |
| No | 73(96.05%) | 36(94.73%) | 37(97.36%) | $\chi^2_1=0.347$ |
| Yes | 3(3.94%) | 2(5.26%) | 1(2.63%) | |
| **Head of the household** | | | | |
| **No** | 71(93.42%) | 34()89.47% | 37(97.36%) | $\chi^2_1=1.927$ |
| **Yes** | 5(6.57%) | 4(10.52%) | 1(2.63%) | |
| **Native of Khuzestan** | | | | |
| No | 20(26.31%) | 14(36.84%) | 6(15.78%) | $\chi^2_1=4.343*$ |
| Yes | 56(73.68%) | 24(63.15%) | 32(84.21%) | |
| **University admission** | | | | |
| Daily Student | 47(61.84%) | 24(63.15%) | 23(60.52%) | |
| Pardis (Tuition-paying student) | 25(32.89%) | 13(34.21%) | 12(31.57%) | $\chi^2_1=1.061$ |
| Transfer | 4(5.26%) | 1(2.63%) | 3(7.89%) | |
| **Academic probation** | | | | |
| No | 73(96.05%) | 35(92.10%) | 38(100%) | $\chi^2_1=3.123$ |
| Yes | 3(3.94%) | 3(7.89%) | 0(0%) | |
| **Entrance exam quota** | | | | |
| No | 57(75%) | 26(68.42%) | 31(81.57%) | $\chi^2_1=1.754$ |
| Yes | 19(25%) | 12(31.57%) | 7(18.42%) | |
| **Time interval from diploma to entering university** | 1.39±1.41 | 1.30±1.47 | 1.47±1.37 | $t_{73}= -0.538$ |

*p<0.05, **p<0.01, ***p<0.001

results of Greenhouse-Geisser F-values, no significant interaction was found between the time and the groups ($F_{(1.73)} = 0.003$, p=0.995). The score of teaching by the traditional method (A) in both tests (1 and 2) was lower than the blended method (B) ($F_{(1.73)} = 11.429$, p<0.001). The results showed that the blended learning method had a positive impact on the students average score (Table 2). In both traditional and blended groups, the second test scores of students significantly decreased compared to the first test scores ($F_{(1.73)} = 7.954$, p<0.01).

## DISCUSSION

The present study examined the effect of the blended learning approach compared with the conventional method in dental education (oral diagnosis course) during the COVID-19 pandemic. The study was set up to allow students to experience learning activities via online and face-to-face learning.

The study of dentistry is subdivided into three basic parts: theoretical subjects, preclinical, and clinical subjects. The COVID-19 pandemic has fundamentally reshaped the global education system and sparked a wave of innovation in education. The theoretical subjects have been changed from face-to-face education to e-learning and distance learning, and rapid progress has been made to strengthen theoretical learning platforms. Nevertheless, there are still challenges and concerns about the preclinical and clinical subjects. In some countries, multiple prevention and control measures were adopted during the COVID-19 pandemic including personal protective equipment, physical separation of teachers from students during the instruction, distance learning, and increasing instruction time (11).

The present study indicated that the mean score of the students via the blended learning method (Group B) was higher than the traditional learning method (Group A), and after one month and the second evaluation, the mean score in both groups decreased, significantly.

Rouhi et al. (2016) compared the effect of traditional and blended instructions on the learning of practical oral pathology course. The results showed a significant difference between the mean scores of traditional and blended instructions. Rouhi et al. suggested the web-based learning as alternative or complementary to traditional instruction (11).

Kavadella et al. (2012) evaluated the effect of the blended method (a combined face-to-face and online instruction) on the undergraduate oral radiology performance and compared it with the traditional method. The results of the study indicated that the mean score of students through the blended method was higher than the traditional method and the learners had positive attitudes towards blended learning elements (teaching, assessment, support, organization, learning resources). Moreover, the students appreciated the course design and clarity of instructions via blended learning. Kavadella et al. suggested the blended learning as effective method for oral radiology instruction (12).

Reissmann et al. (2015) evaluated the effect of the blended learning method in a preclinical course in prosthetic dentistry and concluded that the students' attitudes towards e-learning tool were positive and suggested that learning objective tests can be effectively applied in blended learning environment (13).

Arun Paul et al. (2019) in a cross-sectional comparative study compared the blended learning method with the traditional didactic lecture for instruction of dental undergraduate students and concluded that the blended method (Flipped classroom approach) was better than traditional lecture for instruction of dental undergraduate students (14).

Castro-Rodríguez et al. (2017) evaluated the attitudes of postgraduate students towards the blended learning approach for teaching-learning process and concluded that the postgraduate students were mostly satisfied with online learning and considered it as alternative method for teaching-learning process and evaluation. Similarly, they found that the students' time management skills via blended learning affected students' academic achievement (15).

Bourzgui et al. (2020) studied the effectiveness of the blended learning approach compared with the face-to-face instruction in dental education. The results showed that less than half of the students satisfied with blended learning approach as complementary tools compared with traditional learning process. Moreover, 53.8% of the students believed that online teaching cannot satisfy all educational needs and goals and requires more explanations by teachers. The reason could be explained due to the fact that both formative and interactive evaluations were not enough. Therefore, establishing a tutorial learning system combined with related learning tools (discussion forum, chat room, online assessment) can motivate students to achieve to desired academic (16).

Kumar (2017) in a literature review study compared the effectiveness of e-learning and blended learning with traditional face-to-face learning in orthodontic education and concluded that e-learning classes were as good as or more effective than face-to-face classroom learning. Moreover, student's attitude and acceptance toward e-learning and blended learning were positive and favorable (17).

In this study, the relationship between the socio-demographic factors and the mean scores of the participants

**Table 2. Comparison of the mean score of students from blended and traditional lea**

| Group | Immediate posttest score | One month follow up posttest score | p-value |
|---|---|---|---|
| Group A (Traditional) | 10.42±2.11 | 9.48±2.79 | P<0.001 |
| Group B (Blended) | 12.32±2.41 | 11.27±2.76 | |
| P<0.01 | | | |

was examined. The highest mean score was achieved by indigenous students (native of Khuzestan). The reason can be explained due to issues such as easier life with family, travel cost, accommodation, and reduced classroom teaching time. More studies are recommended to address this issue. No significant difference was observed between other demographic variables

Blended learning with the educational benefits of online learning and face-to-face learning has the greatest impact on the immediate and long-term academic achievement compared to traditional learning. The blended learning model can be used as complementary tools to the traditional learning process during the COVID-19 pandemic.

**Ethical considerations:** Ethical issues including plagiarism, informed consent, misconduct, data fabrication and /or falsification, double publication and/ or submission, redundancy, etc. have been completely observed by the authors. This study was conducted in compliance with the ethical standards in the Declaration of Helsinki and those followed at Ahvaz Jundishapur University of Medical Sciences. Ethical code: IR.AJUMS.REC.1399.592. Written consent forms were obtained from all participants.

## REFERENCES

1. Shahbeigi F, Nazari S. Virtual education: Benefits and limitations. The Journal of Medical Education & Development.2011; 6(1): 47-54.
2. Najafi H. Comparing of the effect of Blended and Traditional teaching on Learning. RME. 2019; 11 (2) :54-63.
3. Esfijani, A. Investigating the Effects of Blended Instruction on Students' Academic Performance and Satisfaction. New Educational Approaches, 2018; 13(1): 45-66.
4. Westbrook V. The virtual learning future. Teaching in Higher Education 2006;11(4): 471-82.
5. Browne L, Mehra S, Rattan R, Thomas G. Comparing lecture and e-learning as pedagogies for new and experienced professionals in dentistry. British Dental Journal. 2004; 197: 95-97.
6. Amir L, Tanti I, Maharani DA , Wimardhani YS , Julia V, et al. Student perspective of classroom and distance learning during COVID-19 pandemic in the undergraduate dental study program Universitas Indonesia. Amir et al. BMC Medical Education (2020) 20:392.
7. Kimovski G, Trajkovic V, Davcev D. VIRTUAL LEARNING SYSTEM. Article. January 2001. See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/242405171
8. Moradi R, Mohamadi Mehr M, Nojoomi F, Khazaie A. The use of design patterns in the design and production of electronic content in e-learning environment. Aja-nama, 2016; 7:41-52.
9. Soltanimehr E, Bahrampour E, Imani MM, Rahimi F, Almasi B, et al. Effect of virtual versus traditional education on theoretical knowledge and reporting skills of dental students in radiographic interpretation of bony lesions of the jaw. BMC Med Educ. 2019; 19:233.
10. Assis Machado R, Rogério Ferreti Bonan P, Elias Da Cruz Perez D, Martelli Júnior H. COVID-19 pandemic and the impact on dental education: discussing current and future perspectives. Braz. Oral Res. 2020; 34:083.
11. Roohi M, Jahanian I, Gholinia H, Abbaszadeh H. A Comparison of Traditional Learning and Combined Traditional-ELearning (web-based) on Dentistry Students' Learning of Practical Oral Pathology Course. J Med Educ Dev. 2016; 9 (21) :47-52
12. Kavadella A, Tsiklakis K, Vougiouklakis G, Lionarakis A. Evaluation of a blended learning course for teaching oral radiology to undergraduate dental students. Eur J Dent Educ. 2011;16 (2012) :88-95.
13. Reissmann D R, Sierwald I, Berger F, Heydecke G. A Model of Blended Learning in a Preclinical Course in Prosthetic Dentistry. Journal of Dental Education.2015;79(2):157-65.
14. Arun Paul S, Priyadarshini H R, Fernandes B, Abd Muttalib Kh, Sylvia Western J, Devaprakash Dicksit D. Blended Classroom versus Traditional Didactic Lecture in Teaching Oral Surgery to Undergraduate Students of Dentistry Program: A Comparative Study. Journal of International Oral Health. 2019; 11 (1):36-39.
15. Castro-Rodríguez Y, Lara-Verástegui R.Perception of blended learning in the teaching-learning process by post-graduate students of Dentistry. Educ Med. 2017. http://dx.doi.org/10.1016/j.edumed.2017.03.028
16. Bourzgui F, Alami S, Diouny S. A Comparative Study of Online and Face-to-Face Learning in Dental Education. EC Dental Science. 2020;19(3):1-11.
17. Kumar A. E-learning and Blended Learning in Orthodontic Education. APOS Trends in Orthodontics.2017;7(4):188-98.